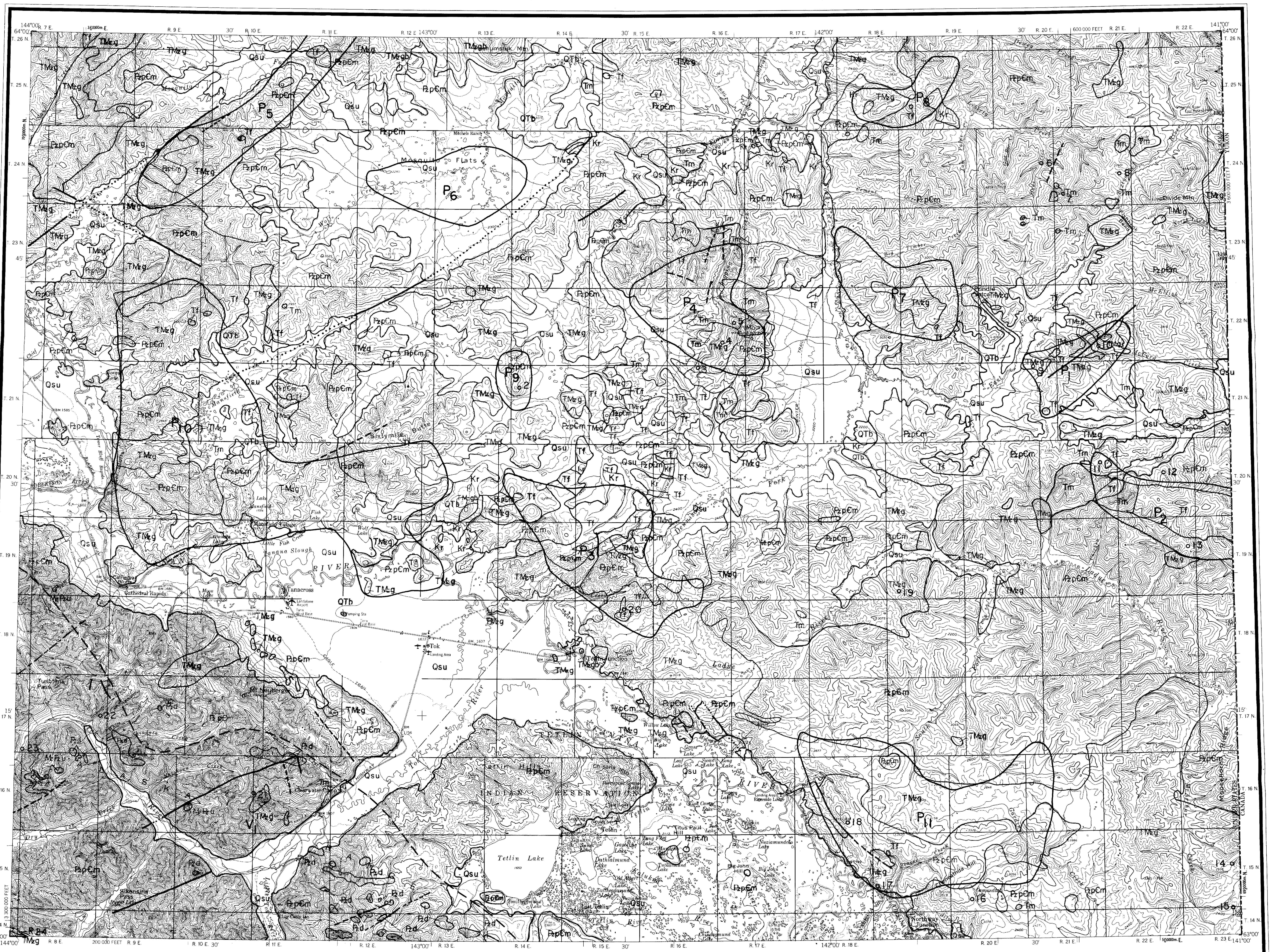
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY



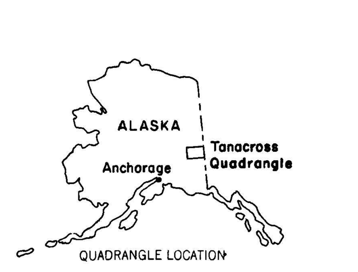
BASE FROM U. S. GEOLOGICAL SURVEY, 1964

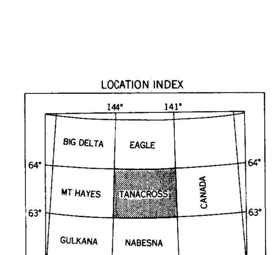
SCALE 1:250 000

5 0 5 10 15 20 25 MILES

5 0 5 10 15 20 25 KILOMETERS

CONTOUR INTERVAL 200 FEET
DATUM IS MEAN SEA LEVEL





MINERAL RESOURCES MAP OF THE TANACROSS QUADRANGLE, ALASKA

BY

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1976

Table 1.--Mineral deposits and occurrences of the Tanacross quadrangle

[P, prospect; M, mine; Q, quarry; A, exploration, development, or production since 1967]

Map no.	Name(s)	Location of claim area	Resource(s)	Type of deposit or occurrence	Development category	Description of deposit or occurrence
1	Mosquito	T. 24 N. R. 10 E.	Cu, Mo	Porphyry copper(?)	P/A	Quartz latite porphry and quartz monzonite.
2	Peternie	T. 21 N. R. 13, 14 E.	Mo, Cu	Porphyry molybdenum and copper	P/A	Deep leaching of quartz monzonite and latite porphyry.
3	---------------	T. 21 N. R. 16 E.	Mn	Lode	P	---------------
4	---------------	T. 22 N. R. 16 E.	Mn, U	Lode	P	---------------
5	Fairplay and other prospects	T. 22 N. R. 16 E.	Cu, Mo, Pb, Zn	Porphyry copper(?)	P/A	Altered Tertiary hypabyssal intrusion; volcanic rocks. Disseminated pyrite and some chalcopyrite.
6	---------------	T. 24 N. R. 20 E.	Au	Placer	P	---------------
7	Pika Canyon	T. 24 N. R. 21 E.	Cu, Zn	Lode	P/A	Disseminated pyrite and chalcopyrite in float. Float and bedrock are either altered granodiorite or gneiss. Igneous rocks crop out in the area.
8	---------------	T. 24 N. R. 21 E.	-------	Lode	P/A	---------------
9	Bluff	T. 21 N. R. 20 E.	Cu, Mo	Porphyry copper	P/A	Disseminated pyrite and chalcopyrite in quartz monzonite and hypabyssal intrusions. Strong hydrothermal alteration with many faults, dikes, and local tourmaline.
10	East and West Taurus	T. 22 N. R. 21 E.	Cu, Mo	Porphyry copper	P/A	---------------Do.---------------
11	Pushbush	T. 20 N. R. 21 E.	Cu, Mo	Porphyry copper(?)	P/A	Disseminated chalcopyrite and pyrite in metamorphic rocks and Tertiary volcanic rocks.
12	Big Creek	T. 20 N. R. 22 E.	-------	Lode	P/A	---------------
13	Ladue Camp	T. 19 N. R. 22 E.	-------	Lode	P/A	---------------
14	B.C.	T. 15 N. R. 23 E.	Au	Vein and placer	P/A	Eluvial (residual) and gold-bearing bench gravels, about 6 m thick, occur over intensely decomposed granodiorite bedrock that has quartz-gold veins. Eluvial gold has delicate wire and crystal forms. Also, creeks in the area tributary to McArthur Creek may have gold placer deposits.
15	Move and other prospects	T. 14, 15 N. R. 23 E.	Au	Lode	P/A	---------------
16	---------------	T. 15 N. R. 20 E.	-------	----------	P/A	---------------
17	---------------	T. 15 N. R. 19 E.	Au	----------	P/A	---------------
18	---------------	T. 16 N. R. 18 E.	-------	----------	P	---------------
19	---------------	T. 19 N. R. 19 E.	-------	Lode	P/A	---------------
20	ASARCO	T. 18, 19 N. R. 15 E.	Cu, Mo	Porphyry copper	P/A	Silicified and deeply leached quartz porphyry and quartz monzonite.
21	Noah	T. 16 N. R. 10, 11 E.	Cu	Lode	P/A	---------------
22	Stibnite, A Lucky Leak, and other prospects	T. 15 N. R. 8, 9 E.	Sb	Veins	M/A	Stibnite in quartz vein enclosed by fault planes. Thickness of vein appears to be about 6 m. The quartz veins cut intricately folded and much faulted metamorphic rocks (Moffit, 1954).
23	Tok	T. 17 N. R. 7 E.	Au(?)	----------	P	---------------
24	---------------	T. 14 N. R. 8 E.	Building stone	Magnesite marble	Q	Marble occurs in a band which is 3 m to 9 m thick and probably a mile long. Rock consists of thin laminae, lenses, and veins of magnesite, dolomite, and quartz in shades of green, cream, and white (Richter, 1967).
1/	On Little Tok River	---------	Au(?)	Placer(?)	P	---------------
1/	Enterprise Creek (tributary of Tok River)	---------	Au	Placer(?)	P	---------------
1/	Sixtymile River	---------	Au	Placer	P	---------------
1/	Boulder Creek (tributary of Tok River)	---------	Sb, Au	----------	P	---------------
1/	Southwest slope of Mount Fairplay	---------	Mn	Lode	P	---------------
1/	Redstreak Gulch	---------	Au	Placer(?)	P	---------------

1/ Locality not shown on map; exact location unknown.

EXPLANATION

GEOLOGY GENERALIZED FROM FOSTER (1970)

CORRELATION OF MAP UNITS

UNCONSOLIDATED DEPOSITS

Qsu — QUATERNARY

SEDIMENTARY ROCKS

Kr — CRETACEOUS(?)

KJm — CRETACEOUS OR JURASSIC

IGNEOUS AND METAMORPHIC ROCKS

QTb — QUATERNARY AND TERTIARY

Tm, Tf — TERTIARY(?)

TMzg, TMzgb — TERTIARY OR MESOZOIC

MzPzu — MESOZOIC OR PALEOZOIC

Pzd — PALEOZOIC(?)

PzpCm — PALEOZOIC AND (OR) PRECAMBRIAN

DESCRIPTION OF MAP UNITS

UNCONSOLIDATED DEPOSITS

Qsu — UNCONSOLIDATED SEDIMENTARY DEPOSITS

SEDIMENTARY ROCKS

Kr — DETRITAL ROCKS (CRETACEOUS?)

KJm — MENTASTA ARGILLITE OF RICHTER (1967) (JURASSIC OR CRETACEOUS)

IGNEOUS AND METAMORPHIC ROCKS

QTb — BASALT

Tm — MAFIC VOLCANIC ROCKS

Tf — FELSIC TUFF, WELDED TUFF, LAVA, AND HYPABYSSAL INTRUSIVE ROCKS

TMzg — GRANITIC ROCKS, UNDIVIDED

TMzgb — GABBRO

MzPzu — ULTRAMAFIC ROCKS

Pzd — DIORITE

PzpCm — METAMORPHIC ROCKS, UNDIVIDED

GEOLOGIC SYMBOLS

CONTACT, APPROXIMATELY LOCATED

FAULT, DASHED WHERE APPROXIMATELY LOCATED, DOTTED WHERE CONCEALED. U, UPTHROWN SIDE; D, DOWNTHROWN SIDE

FAULT OR LINEAMENT FROM AERIAL PHOTOGRAPHS

SYMBOLS FOR FAVORABLE MINERAL RESOURCE AREAS

P_1 — FAVORABLE AREA FOR PORPHYRY COPPER AND MOLYBDENUM DEPOSITS (SOME AREAS, PARTICULARLY P_8, P_{10}, AND P_{11} MAY HAVE MINERALIZATION OTHER THAN PORPHYRY COPPER AND MOLYBDENUM)

V_1 — VEIN OR FISSURE DEPOSITS

○2 — PROSPECT, QUARRY, OR MINE. NUMBER ON MAP IS PLACED NEAR APPROXIMATE CENTER OF OCCURRENCE OR PROSPECT(S). IN PLACES, SEVERAL PROSPECTS AND GROUPS OF CLAIMS ARE INCLUDED UNDER ONE NUMBER.

DEPOSIT TYPE AND CRITERIA FOR SELECTION OF FAVORABLE MINERAL RESOURCE AREAS

Favorable areas	Criteria used to define areas 1/
P_1	a. Known deposits (9 and 10). 2/ b. Favorable rock type crops out (Tertiary felsic volcanic and hypabyssal rocks). c. Occurrence of favorable rocks interpreted from aeromagnetics. d. High copper and lead values in stream-sediment samples. e. High tin, lead, and copper values in oxide residue of stream sediment. f. High boron and lead content in rock samples. g. High bismuth and tungsten values in heavy-mineral concentrates. h. Favorable structural features interpreted from Landsat. i. Abundant sulfides observed in field.
P_2	a. Prospects present (11 and 13). b. Favorable rock type crops out. c. High lead and tin values in stream-sediment samples. d. High copper, molybdenum, zinc, and lead values in oxide residue of stream sediment. e. High tin and lead values in ash of aquatic bryophytes (mosses). f. Sulfides observed in western part. g. Cassiterite observed in central part. h. High tin and tungsten in heavy-mineral concentrates.
P_3	a. Known deposit (20). b. Favorable rock type crops out. c. Occurrence of favorable rock in part of area interpreted from aeromagnetics. d. High copper values in stream-sediment samples. e. High tungsten values in heavy-mineral concentrates. f. Sulfides observed in field.
P_4	a. Prospects present (4 and 5). b. Occurrence of favorable rock in part of area interpreted from aeromagnetics. c. Favorable rock type crops out. d. High lead and zinc values in stream-sediment samples. e. High molybdenum, lead, and zinc values in rock samples. f. High tin and lead values in ash of aquatic bryophytes (mosses). g. High tungsten values in heavy-mineral concentrates. h. High copper, molybdenum, and lead values in oxide residue of stream sediment. i. Favorable structural features interpreted from Landsat.
P_5	a. Known deposit (1). b. Favorable rock crops out. c. Occurrence of favorable rock interpreted from aeromagnetics. d. High lead, tin, molybdenum, gold, bismuth, and tungsten values in rock samples. e. High lead values in stream-sediment samples. f. High bismuth and tungsten values in heavy-mineral concentrates. g. High tin and lead values in ash of aquatic bryophytes (mosses). h. High molybdenum values in ash of streambank sod. i. High molybdenum, lead, and zinc in oxide residue of stream sediment. j. Abundant sulfides observed in field.
P_6	a. Occurrence of favorable rock type interpreted from aeromagnetics. b. High silver, zinc, lead, and molybdenum values in ash of streambank sod. c. High copper values in oxide residue of stream sediment.
P_7	a. Favorable rock crops out. b. High molybdenum and tin values in rock samples. c. High tin values in stream-sediment samples. d. High copper and tin values in oxide residue of stream sediment. e. High zinc value in ash of aquatic bryophytes (mosses). f. High tungsten values in heavy-mineral concentrates.
P_8	a. Favorable rock crops out. b. High lead values in stream-sediment samples. c. High zinc value in oxide residue of stream sediment. d. High lead and zinc values in ash of aquatic bryophytes (mosses). e. High molybdenum, tin, and lead values in rock sample of sandstone. f. Sulfides observed in field.
P_9	a. Known deposit (2). b. Favorable rock crops out. (Small outcrops of felsic volcanic and hypabyssal rocks that are not shown on geologic map.) c. High values of molybdenum and zinc in rock samples. d. Favorable rock interpreted from aeromagnetics. e. Sulfides observed in field.
P_{10}	a. Favorable rock crops out. b. High tin and molybdenum values in rock samples. c. High copper, silver, lead, and zinc values in stream-sediment samples. d. High molybdenum, tin, and zinc values in ash of aquatic bryophytes (mosses). e. Tin and zinc values in oxide residue of stream sediment. f. High tungsten and bismuth content in heavy-mineral concentrates. g. High lead, zinc, gold, cobalt, and molybdenum values in ash of streambank sod. h. Favorable rock in part of area interpreted from aeromagnetics. i. Sulfides observed in eastern part.
P_{11}	a. Small outcrops of favorable rock. b. High tin, copper, lead, and zinc values in stream-sediment samples. c. High molybdenum and zinc values in oxide residue of stream sediment. d. High tin, tungsten, and bismuth contents in heavy-mineral concentrates. e. High lead and zinc values in ash of aquatic bryophytes (mosses). f. Favorable structural features in west half interpreted from Landsat. g. Abundant sulfides observed in field.
V_1	a. Known stibnite vein (22). b. High values of copper, silver, gold, molybdenum, zinc, and boron in rock samples. c. High lead, copper, zinc, and arsenic values in stream-sediment samples. d. High silver, zinc, lead, and gold values in ash of streambank sod. e. High copper, molybdenum, zinc, and lead in oxide residue of stream sediment. f. High copper and lead values in heavy-mineral concentrates. g. Scheelite, chalcopyrite, and copper-rich pyrite in heavy-mineral concentrates. h. Abundant sulfides observed in field.

1/ Sources of information for the various criteria are: Foster (1970), geology; Curtin and others (1976a-h), O'Leary and others (1976), Tripp and others (1976), and Clark and Foster (1969), geochemistry; Griscom (1976), aeromagnetics; and Albert and Steele (1976), Landsat imagery.

2/ Numbers in parentheses are deposits and occurrences listed in table 1 and shown on the resource map.

DISCUSSION

Areas favorable for the occurrence of two types of mineral deposits are delineated on the map. Known deposits and occurrences are also shown on the map and available data on them are provided in table 1. Information from the known deposits combined with geologic, geochemical, geophysical, and earth satellite data presented in the other components of the Tanacross folio provide the basis for the selection of favorable areas. However because bedrock exposure is poor in the Tanacross quadrangle, types of deposits other than those now known to occur may eventually be found, and boundaries of the areas delineated as favorable may change as more information, particularly from drilling, is obtained. Criteria used to select each of the favorable areas are listed. A discussion of mineral resources and a consideration of the potential for the occurrence of other types of deposits in the quadrangle follow.

Mineral Resources

Coal.--Thin lignitic beds occur in the Late Cretaceous or early Tertiary nonmarine sedimentary rocks in the vicinity of the West Fork. Geologic environments favorable for the occurrence of coal deposits have very limited areal extent in the quadrangle. Small local deposits of peat and organic material associated with unconsolidated Quaternary deposits are scattered throughout the quadrangle.

Geothermal energy.--Rocks favorable for geothermal energy do not exist in the quadrangle. The volcanic rocks either are older than 0.5 million years or are mafic.

Petroleum.--The Tanacross quadrangle is not considered to have any significant potential for oil and gas. Rock types that could contain petroleum are not known to occur in the quadrangle. A limited amount of gas (mostly methane) has been found in unconsolidated Quaternary deposits in the valley of the Tanana River, but commercial amounts have not been found.

Radioactive minerals.--Radiometric investigations in the quadrangle (Wedow, Killeen, and others, 1954; Matzko and Freeman, 1963; and White and others, 1963) identified several weakly radioactive areas near Mount Fairplay and Northway Junction. Field examinations (Wedow, Killeen, and others, 1954; and White and others, 1963) indicate that the anomalies are probably from zircon and minor concentrations of other unidentified minerals.

Checks for radioactivity of samples with Geiger or scintillation counters did not indicate any anomalous samples. Geologic information and checks for radioactivity imply that the quadrangle has a low potential for large uranium or thorium deposits.

Copper.--Copper is an important mineral resource of the Tanacross quadrangle. It is known to occur in porphyry deposits, but a variety of other copper-bearing deposits, such as massive sulfide, vein, and skarn, could also occur.

Six possible porphyry copper deposits (map numbers 1, 2, 5, 9, 10, and 20) have been tentatively identified in the quadrangle. These deposits are associated with Mesozoic quartz monzonite or, in one case, Tertiary syenite (5), and all appear to be genetically related to Tertiary felsic volcanic or hypabyssal rocks. Not all of the deposits have been drilled, and those that have been drilled are not completely delineated; for this reason it is not possible to say that there are definitely six or more porphyry copper occurrences in the quadrangle. Evidence is strong, however, that there are at least four deposits. On the basis of the consistency of the information used in selecting favorable areas and the number and size of these areas, a subjective estimate of the number of porphyry deposits that occur in the quadrangle is:

(1) a 90 percent chance that there are four or more deposits,

(2) a 50 percent chance that there are six or more deposits, and

(3) a 10 percent chance that there are nine or more deposits.

The relatively low number of deposits estimated reflects not only lack of confidence that all of the identified porphyries will eventually prove to be porphyries when drilled, but also the existence of some inconsistencies in the information used to select some of the favorable areas. For example, one of the suggestions of mineralization in area P_8 is high molybdenum, tin, and lead values in an unaltered sandstone sample that is older than the apparent source of porphyry mineralization in the quadrangle--the Tertiary felsic volcanic rocks. In areas P_{10} and P_{11} the high geochemical values are widely distributed, making it difficult to identify a single mineralized source for the high values. Small altered and mineralized veins are the only direct evidence of mineralization observed in area P_{10}. These and other veins may be the only source of the high metal values in the various sample media. The high metal values in areas P_8 and P_{11} may have been derived from similar sources.

Available information from the limited amount of drilling by industry in the quadrangle suggests that the porphyries have a low copper and molybdenum content by comparison with deposits in the conterminous United States, but at least one prospect is similar in grade, tonnage, and some geologic features to many deposits in British Columbia and Yukon Territory, some of which are presently being mined. Information from the frequency distribution of tonnages of 21 porphyries in western Canada (Singer and others, 1975) is, therefore, used to estimate the tonnages in Tanacross. Although it is possible for these unglaciated porphyries to have enriched supergene zones, available information suggests that average grades in Tanacross are lower than those in similar deposits in the Nabesna quadrangle to the south (Richter and others, 1975). The estimated percentage of porphyry deposits that will have various average grades and tonnage when completely drilled is:

Tonnage

(1) 90 percent $\geq$60 million tonnes,

(2) 50 percent $\geq$180 million tonnes, and

(3) 10 percent $\geq$500 million tonnes.

Grade

(1) 90 percent $\geq$0.10 percent copper,

(2) 50 percent $\geq$0.25 percent copper, and

(3) 10 percent $\geq$0.50 percent copper.

The possibility of other types of copper deposits in the Tanacross quadrangle, such as massive sulfide, stratiform, skarn, and vein, should not be overlooked. Small copper-bearing vein deposits are known to be scattered throughout the quadrangle. Skarn deposits are found in geologic settings in Canada (Gleeson and Brummer, 1976) similar to those found in parts of the Tanacross quadrangle. If such deposits occur in Tanacross, they are probably small because no aeromagnetic anomalies suggesting skarns can be found. In Canada (Gleeson and Brummer, 1976), some massive sulfide deposits are in metamorphic rocks similar to those in Tanacross. Widespread pyrite occurrences and numerous copper, lead, and zinc anomalies in the metamorphic rocks suggest that Tanacross could also have massive sulfide deposits. A stratiform deposit containing chalcopyrite and bornite in a gneissic granodiorite has been discovered near Minto in Yukon Territory (Gleeson and Brummer, 1976); similar geologic environments exist in parts of the Tanacross quadrangle. If Tanacross contains massive sulfide or stratiform deposits, our appraisal of copper and possible lead, silver, and zinc resources would need to be reevaluated.

Molybdenum.--The molybdenum resources of the Tanacross quadrangle are in the porphyry copper deposits. Information on molybdenum grades in these deposits is not available; however, our analysis of reported grades indicates that about 90 percent of Canadian copper porphyries have grades greater than 0.01 percent molybdenite, about 50 percent of the deposits have grades greater than 0.035 percent molybdenite, and about 10 percent of the deposits have grades greater than 0.045 molybdenite.

Gold.--Eluvial and alluvial gold-bearing gravels, about 6 m thick, were discovered in 1975 in an area that straddles the Alaska-Yukon boundary (map numbers 14 and 15). The source of the gold is probably quartz-gold veins in local granodiorite. This deposit has not yet been evaluated. Scattered gold geochemical anomalies and several attempts at placer mining suggest that small amounts of gold are present in several Tanacross streams. On the basis of the geochemical values, vein gold deposits might be in area V_1.

Antimony.--A stibnite-quartz vein (map number 22) is now being mined. According to Moffit (1954), the stibnite vein is enclosed by fault planes and is slightly less than 6 m thick with a central part, about 2 m thick, of high-grade rock consisting of stibnite and a little quartz. Other stibnite veins of similar size probably also occur in area V_1.

Other metals.--Widely scattered lead, zinc, and silver anomalies and the occurrence of massive sulfide deposits elsewhere in geologic settings like that of Tanacross (Gleeson and Brummer, 1976) suggest that massive sulfide deposits containing lead, zinc, silver, and copper might exist in the quadrangle. Small vein deposits of lead, zinc, and silver could be in area V_1.

Platinum and palladium were detected in anomalous amounts in five rock samples from small ultramafic bodies in T. 14, 16 N., R. 8 E. The platinum values range from 0.002 to 0.07 ppm, and the palladium values range from 0.005 to 0.05 ppm. Higher grade bodies may exist, but their tonnages are likely to be small. Anomalous concentrations of chromium and nickel are also associated with these bodies and with the ultramafic bodies in the northeast part of the quadrangle.

Tin and tungsten anomalies occur in stream-sediment samples and heavy-mineral concentrates, and tin anomalies occur in rock samples. Many of the anomalies are probably related to porphyry copper mineralization in and near Tertiary felsic volcanic rocks. Some of the tungsten anomalies may be from small veins. Some of the tin anomalies could be from low-grade tin mineralization in Tertiary felsic volcanic rocks similar to deposits in Mexico (Sainsbury, 1969). The resource potential for these two elements is probably small.

Several claims were filed many years ago for manganese near Mount Fairplay, but our investiations did not find any evidence of large manganese deposits.

Nonmetals.--The Tanacross quadrangle contains large quantities of sand, gravel, and rock materials suitable for crushed stone. It also contains some carbonate rocks suitable for lime and possibly cement. A small amount of marble has been quarried as ornamental stone in the southwestern corner of the quadrangle (map number 24) (Richter, 1967). High transportation costs for these commodities make it likely that they will be exploited only for local highway construction and other local needs.

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